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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|-------------------------|------------------|
| 09/768,195 | 01/23/2001 | Hiroki Endo | KNI-145-A | 1960 |
| 7590 | 10/30/2003 | | | EXAMINER |
| CARRIER, BLACKMAN & ASSOCIATES, P.C. 24101 NOVI ROAD #100 NOVI, MI 48375 | | | KIELIN, ERIK J | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2813 | |
| | | | DATE MAILED: 10/30/2003 | |
| | | | 17 | |

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|------------------------|--------------------------|------|
| Office Action Summary | Application No. | Applicant(s) | |
| | 09/768,195 | ENDO ET AL. <i>Aw</i> | |
| | Examiner | Art Unit | 2813 |
| | Erik Kielin | | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) Responsive to communication(s) filed on 24 September 2003.

2a) This action is FINAL. 2b) This action is non-final.

3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) Claim(s) 1-22 is/are pending in the application.

4a) Of the above claim(s) 13-22 is/are withdrawn from consideration.

5) Claim(s) _____ is/are allowed.

6) Claim(s) 1-12 is/are rejected.

7) Claim(s) _____ is/are objected to.

8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) The specification is objected to by the Examiner.

10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11) The proposed drawing correction filed on _____ is: a) approved b) disapproved by the Examiner.
 If approved, corrected drawings are required in reply to this Office action.

12) The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) All b) Some * c) None of:

1. Certified copies of the priority documents have been received.

2. Certified copies of the priority documents have been received in Application No. _____.

3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) The translation of the foreign language provisional application has been received.

15) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) Notice of References Cited (PTO-892) 4) Interview Summary (PTO-413) Paper No(s). _____ .

2) Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) Notice of Informal Patent Application (PTO-152)

3) Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ . 6) Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 24 September 2003 has been entered.

Election/Restrictions

2. Applicant's traversal of the restriction by original presentation is acknowledged. The addition of more new claims 20-22 is also acknowledged. Additional new claims 20-22 depend from non-elected claim 14, and are also restricted by original presentation. Applicant's has not made an election of claims beyond the claims originally presented (claims 1-12). Accordingly, the arguments presented in Paper No. 12 are incomplete for failure to elect claims.

The traversal of the restriction requirement is on the ground(s) that "the claims are directed to the *same invention*," (emphasis in original), as stated by Applicant. This is not found persuasive because, if the claims were drawn to the "same invention," then the claims would be duplicates and would be at least obvious over the rejection of the claims already presented. However, the new claims 13-22 contain different limitations drawn to the materials from which a low dielectric constant material is made and method for making the low k dielectric material. By contrast, the original claims are drawn to keeping the oxygen content low while heating and curing the low dielectric constant material regardless of its composition. Accordingly, the new

claims are drawn to a distinct species. This is repeated from the previous Office action, filed 24 March 2003 (Paper no. 10). If Applicant had properly submitted the claims 13-22 along with the original claims, then a restriction could have properly been carried out before examination on the merits. Moreover, there is no generic claim and Applicant is not entitled to rejoinder of claims since there exists no allowable generic claims.

The requirement is still deemed proper and is therefore made FINAL.

Accordingly, claims 1-12 are active and claims 13-22 are withdrawn from further consideration, there being no allowable generic claim.

Claim Objections

3. Claim 9 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Independent claim 1 requires the low dielectric constant material to be organic and have from 5 to 25% carbon by weight. Claim 9 broadens this limitation to include just organic SOG or inorganic SOG. Moreover, the organic SOG cannot also be inorganic SOG.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Art Unit: 2813

5. Claims 1-12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites the limitation “atomic weight %.” This is unclear, there is no such designation. It is either “atomic %” or “weight %” it cannot simultaneously be both.

For the purposes of patentability, the claims will be interpreted as best understood by Examiner.

The remaining claims are rejected for depending from the above rejected claims.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 1, 2, and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent Application Publication 2001/0029111 A1 (**You et al.**) in view of the Handbook of Low and High Dielectric Constant Materials and Their Applications, Nalwa, ed.; Academic Press: San Diego, 1999, pp. 52-53 (the **Handbook**, hereafter).

Regarding claims 1 and 9, **You** discloses a method of forming a coating film in an isolated process chamber which allows spin-on of low dielectric materials, solvent evaporation and curing, all under a controlled environment comprising,

applying a raw material of low dielectric constant (paragraphs [0072]-[0073]) onto a surface of a plate-like material 208 (Fig. 2) to be treated;

reducing the oxygen concentration in the atmosphere surrounding the plate-like material to be less than or equal to 1% before a surface temperature of said plate-like material to be treated rises to 200 °C (paragraph [0153]); thereafter

heating said plate-like material to be treated to a temperature greater than or equal to 400 °C (paragraphs [0146]-[0147]); and then

maintaining the oxygen content in the atmosphere to be less than or equal to 1% until the surface temperature of said plate-like material to be treated lowers to 200 °C (paragraph [0153]).

Note paragraph [0153] states, “The combination of step-ramp curing and an **inert gas environment for heating, high temperature cure, and cooling steps** can provide thin films with high mechanical strength and minimized oxidation, therefore leading to thin films having lower dielectric constants, such as below about 3.0.” (Emphasis added.) Accordingly, the heating, curing, and cooling steps in the above-mentioned paragraphs are carried out in an atmosphere of 0% oxygen because an “inert atmosphere” is used. Note also that the same purpose for using the no/low-oxygen environment in **You** is the same as that indicated by Applicant. (See instant specification section entitled “SUMMARY OF INVENTION.”)

Regarding claim 2, Fig. 1a of **You** discloses purging gas lines 130 to control the chamber atmosphere. Nitrogen gas as the inert atmosphere is disclosed in paragraph [0153].

Further regarding claim 9, see paragraphs [0072]-[0073] and [0139] for the low k materials.

You does not teach that the low k dielectric material has a carbon content of 5 to 25 atomic weight %.

The **Handbook** teaches the methylsilsesquioxane (MSSQ), a sibling compound to HSQ, is known for use in microelectronic electronic circuits for an interlayer dielectric and provides a lower dielectric constant than HSQ as well as greater thermal stability and crack resistance. The **Handbook** also teaches that the curing temperature is about 400 °C, which is consistent with the temperatures used for HSQ in **You**.

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use MSSQ as the low k dielectric in **You**, because **You** suggests that the method disclosed therein is appropriate for both organic and inorganic, low-k, spin-on dielectrics for use as interlayer dielectrics --specifically HSQ-- (**You**, paragraphs [0072]) and because the **Handbook** teaches that MSSQ is better than HSQ.

Finally, given the stoichiometry of MSSQ, there is 1 carbon atom per 7.5 atoms (the hypothetical 0.5 atom being the bridging oxygen), which is 13.5 atomic % carbon. Similarly, given the gram atomic weights of carbon, hydrogen, oxygen and silicon, the weight percent carbon is 14.4%.

Moreover, it has been held that the selection of a known material based on its suitability for its intended use is *prima facie* obvious. The selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 1945) (Claims to a printing ink comprising a solvent having the vapor pressure characteristics of butyl carbitol so that the ink would not dry at room temperature but would dry quickly upon heating were held

invalid over a reference teaching a printing ink made with a different solvent that was nonvolatile at room temperature but highly volatile when heated in view of an article which taught the desired boiling point and vapor pressure characteristics of a solvent for printing inks and a catalog teaching the boiling point and vapor pressure characteristics of butyl carbitol. "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle." 65 USPQ at 301.). See also *In re LESHIN*, 125 USPQ 416 (CCPA 1960) ("Mere selection of known plastics to make container-dispenser of a type made of plastics prior to the invention, the selection of the plastics being on the basis of suitability for the intended use, would be entirely obvious; and in view of 35 U.S.C. 103 it is a wonder that the point is even mentioned.") (See MPEP 2144.07.)

8. Claims 3, 7, and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over **You** in view of the **Handbook** as applied to claim 1, above, and further in view of US 5,431,700 (**Sloan**).

The prior art of **You** in view of the **Handbook**, as explained above, teaches all of the features of the claims except for controlling the surface temperature of the wafer by selectively moving the wafer relative to a hot-plate positioned over a cold plate (claims 3 and 7) while the moving is carried out by a elevator means extending through the cold plate (claim 8), as shown in Applicant's Fig. 2.

Sloan teaches a method of controlling the surface temperature of a semiconductor wafer 12 (plate-like material) for heating and for cooling operations using a hot plate 26 positioned

over a cooling plate **42** with elevator means **70** having pins **62** extending through the cooling plate (cover Fig.; paragraph bridging cols. 4-5).

It would have been obvious to one of ordinary skill at the time of the invention to use the temperature control method taught by **Sloan** in the method disclosed by **You** in view of the **Handbook** for the many beneficial reasons indicated in **Sloan**, such as uniform heating, reduced contamination, etcetera. (See **Sloan Abstract**.)

Although each of the structural features of Applicant's claims is taught in **Sloan**, note that it has been held that to be entitled to weight in method claims, the recited structure limitations therein must affect the method in a manipulative sense, and not amount to the mere claiming of a use of a particular structure. See *Ex parte Pfeiffer*, 1962, C.D. 408 (1961). Accordingly, Applicant should phrase the claims having apparatus structure, such that the structural elements are manipulative of the method.

9. Claims 4 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over **You** in view of the **Handbook** as applied to claim 1, above, and further in view of either of Applicant's admitted prior art (**AAPA**) and **Wolf**, Silicon Processing for the VLSI Era, Vol. 2 : Process Integration, Lattice Press: Sunset Beach, CA 2000, pp. 797-801.

The prior art of **You** in view of the **Handbook**, as explained above, teaches all of the features of the claims except for further processing an interlayer insulation layer by a damascene method.

Each of **AAPA** and **Wolf** teaches the reasons it is common in the art to process an interlayer insulation layer of low dielectric constant by a damascene method, in order to

interconnect semiconductor devices. (See instant specification, section entitled "Description of Prior Art" and associated Figs. 1(a)-1(h). See also **Wolf**, pp. 797-801 -- especially Fig. 15.60).

It would have been obvious to one of ordinary skill at the time of the invention to process the interlayer insulation film of **You** in view of the **Handbook** by a damascene method as taught by either of **AAPA** and **Wolf** in order to form interconnect for semiconductor devices, which is essential in the art and because the **You** method and dielectric materials and the **Handbook** dielectric materials are for the formation of interlevel dielectrics for semiconductor devices (Abstract; paragraph [0009]).

Regarding claim 10, **You** and the **Handbook** both disclose that the interlayer insulation film beneficially has a low dielectric constant of 3.0 or less, as noted above.

10. Claims 5-6 and 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over **You** in view of the **Handbook** and **Sloan** as applied to claims 1-3, above, and further in view of either of **AAPA** and **Wolf**.

The prior art of **You** in view of the **Handbook** and **Sloan**, as explained above, teaches all of the features of the claims except for further processing an interlayer insulation layer by a damascene method.

Regarding claims 5 and 6, either of **AAPA** and **Wolf** is applied as above.

Regarding claims 11-12, **You** and the **Handbook** each disclose that the interlayer insulation layer beneficially has a low dielectric constant of 3.0 or less, as noted above.

Response to Arguments

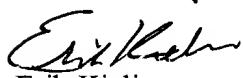
11. Applicant's arguments with respect to claims 1-12 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



Erik Kielin
Primary Examiner
October 28, 2003